APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

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TITLE OPERATIONS USING THE INTEGRATED PARTIAL LIFTING ASSEMBLY (IPPLA) AND CARGO ELEMENT LIFTING ASSEMBLY (CELA) AT THE O&C BUILDING AND THE SSPF.

DOCUMENT NUMBER/TITLE OMI L5131, INTEGRATED PARTIAL PAYLOAD LIFTING ASSEMBLY (IPPLA) OPERATIONS - O&C; AND OMI L5166, CARGO ELEMENT LIFTING ASSEMBLY (CELA) - O&C/SSPF

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REQUIRED APPROVAL

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NASA SUSPENDED LOAD OPERATION ANALYSIS/APPROVAL

OPERATIONS

1. To remove or install the pallet from or into the Payload Segment Structure Integration Trolley (PSSIT).

2. To remove or install the pallet from or into the Pallet Transfer Cage (PTC).

3. To remove or install the Spacelab Transfer Tunnel (STT) from or into the tunnel dolly/workstand.

4. To remove or install Mission Peculiar Equipment Support Structure (MPESS) from or into the Shipping Cradle.

5. To install payload into the Canister.

SUPPORTING DOCUMENTS - The associated operational procedure and System Assurance Analysis (SAA) are as follows:

- OMI L5131, Integrated Partial Payload Assembly (IPPLA) Operations, O&C

  OMI L5166, Cargo Element Lifting Assembly (CELA)- O&C/SSPF

- SAA01FS027-002, 27.5 Ton Bridge Cranes - O&C

  SAA21CRS1-001, 30 Ton Highbay Bridge Cranes - Space Station Processing Facility (SSPF)

GENERAL DESCRIPTION

1. Removal or installation of the pallet from or into the PSSIT requires a maximum of three persons under the suspended pallet and IPPLA/CELA hoist beam to remove or install a set of pallet support struts (weighing approximately 125 lbs.).

2. Removal or installation of the pallet from or into the PTC requires a maximum of three persons under the suspended pallet and IPPLA/CELA hoist beam to remove or install a set of pallet support struts (weighing approximately 125 lbs.).
3. Removal or installation of the STT from or into the tunnel dolly/workstand may require a maximum of four persons under the suspended STT and IPPLA hoist beam to remove or install the PIP pins and bracket, guide the tunnel, and "spot" the operation.

4. Removal or installation of MPESS from or into the shipping cradle requires four persons to work under the suspended load in order to install or remove the MPESS to cradle interface bolts.

5. Installation of the payload into the canister requires two persons under the suspended load to conduct general keel trunnion inspection for raised metal prior to installation into the canister.

These tasks are completed in the following OMI L5131/L5166 sequences:

- Removal of Pallet from PTC
- Removal of Pallet from PSSIT
- Remove STT from Dolly/Workstand
- Remove GBA/MPESS from Shipping Cradle, GBA Cradle, or Cradle
- Install Pallet into PTC
- Install Pallet into PSSIT
- Install payload into Test Stand (TS), Trunnion Support Fixture (TSF), Canister, or SPRD
- Install STT onto Dolly/Workstand
- Install GBA/MPESS into Shipping Cradle, GBA Cradle, or Cradle

These tasks require personnel to be in the area of increased hazard directly under the suspended pallet, MPESS, payload or STT and the IPPLA/CELA hoist beam for IPPLA/CELA operations. OMI L5131/L5166 is the controlling procedure, which is used in the Operations and Checkout Building (O&C) low bay and the Space Station Processing Facility (SSPF).

During contingency payload grounding operations, one person will be permitted to work under the suspended load.

RATIONALE/ANALYSIS - The suspended load tasks comply with the NASA Alternate Safety Standard as follows:

Alternate Standard Requirement #1a - These tasks cannot be conducted without placing personnel beneath the suspended pallet, MPESS, payload or STT and the IPPLA/CELA hoist beam because there is no other access to the hardware attach points.

The pallet is tapered by design with the support struts located inboard on the tapered portion of the pallet, which places personnel beneath the IPPLA /CELAhoist beam and part of the pallet.

The PIP pins and brackets are located on the bottom side of the tunnel, which places personnel under the IPPLA hoist beam as well as the tunnel.

The MPESS attaches to its cradle by a number of bolts, nuts, and washers which must be installed/removed under and inboard of the IPPLA/CELA structure.

During all of these operations, the load must be hoisted above its appropriate holding fixture to provide access for hardware removal or installation. As a result, there are no operational or procedural means to eliminate personnel exposure to the suspended load because of lack of access to the attach points.

The design of additional support structures for the load is not feasible because access to the attach points would be blocked.

Alternate Standard Requirement #1b - The possible use of a secondary support system, to catch the load in the event of a crane failure, was analyzed. It was determined that the use of a secondary support system was not feasible because of positioning of the pallet over the PSSIT or PTC, the STT over the tunnel dolly/workstand or MPESS over the cradle.

Alternate Standard Requirement #1c

1. The maximum number of personnel allowed under the suspended pallet and IPPLA/CELA hoist beam during removal or installation of the pallet support struts (for removal or installation of the pallet from or into the PSSIT) is three.

2. The maximum number of personnel allowed under the suspended pallet and IPPLA/CELA hoist beam during removal or installation of the pallet support struts (for removal or installation of the pallet from or into the PTC) is three.

3. The maximum number of personnel allowed under the suspended STT and IPPLA hoist beam during removal or installation of the PIP pins and brackets, guiding the tunnel, and "spotting" the operation (for removal or installation of the STT from or into the tunnel dolly/workstand) is four.

4. The maximum number of personnel allowed under the suspended MPESS pallet and IPPLA/CELA hoist beam during installation or removal of MPESS to cradle interface bolts (for removal or installation of MPESS from or into the cradle) is four.

5. The maximum number of personnel allowed under the suspended payload and IPPLA/CELA hoist beam during general inspection of the keel trunnion for raised metal prior to installation into the canister is two.

Alternate Standard Requirement #1d

1. Removal or installation of the pallet support struts will be accomplished as quickly and safely as possible to minimize exposure time. It will take three persons five minutes (two times) to remove or install the pallet support struts for PSSIT operations.

2. Removal or installation of the pallet support struts will be accomplished as quickly and safely as possible to minimize exposure time. It will take three persons five minutes (two times) to remove or install the pallet support struts for PTC operations.

3. Removal or installation of the PIP pins and bracket, guiding the tunnel, and "spotting" the operation will be accomplished as quickly and safely as possible to minimize exposure time. It will take four persons 30 minutes to remove or install the PIP pins and bracket, guide the tunnel, and "spot" the operation for STT and tunnel dolly/workstand operations.

4. Removal or installation of the MPESS to cradle interface bolts will be accomplished as quickly and safely as possible to minimize exposure time. It will take four persons up to two hours to remove or install the bolts.

5. General inspection of the keel trunnion prior to installation of the payload into the canister will be accomplished as quickly and safely as possible to minimize exposure time. It will take two persons approximately one minute to verify the keel is free of any raised metal.

Alternate Standard Requirement #4 - OMI L5131 and OMI L5166 have been revised to permit only the approved number of persons under any of the combinations of suspended loads covered in this report. The OMI is available on site for inspection during the operation.

Alternate Standard Requirement #6 - The suspended load operations covered by this report are conducted in the O&C and involve one of the 27.5 ton bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

The 27.5 ton crane hoists are equipped with two magnetic holding brakes (one on the motor shaft and one on the gear reducer input shaft extension), each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the rated load (27.5 tons) is verified annually. The cranes are designed to meet a 5 to 1 safety factor based on ultimate strength for the hoist load bearing components.

The IPPLA weights 11,000 lbs. The weight of the pallet is 8,600 lbs., which in combination with the IPPLA is 35.6% of the crane's capacity. The weight of the STT is 1,500 lbs., which in combination with the IPPLA is 22.7% of the crane's capacity. The weight of the MPESS is 8,000 lbs. and combined with the IPPLA is 34.5% of the crane's capacityThe CELA weighs 22,500 lbs. The weight of the MPESS is 8,000 lbs. and combined with the CELA is 51% of the crane's capacity. The weight of the pallet is 8,600 lbs, which in combination with the CELA is 52% of the crane's capacity. The weight of the STT is 1,500 lbs., which in combination with the CELA is 40% of the crane's capacity. The CELA is rated at 36,500 pounds and is designed to meet a 5 to 1 safety factor based on ultimate strength.

The 27.5 ton cranes are load tested annually at 100% of their rated capacity. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the cranes to ensure proper operation. A detailed inspection of the lifting slings is performed annually. Nondestructive testing of the slings and crane hooks is performed annually.

The suspended load operations addressed in this analysis involve one of the 30 ton SSPF bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9. The SSPF 30 ton crane hoists are equipped with two magnetic holding brakes, each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the rated load (30 tons) is verified annually. The cranes are designed to meet a 5 to 1 safety factor based on ultimate strength for the hoist load bearing components. The 30 ton cranes are load tested annually at 100% of their rated capacities. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the cranes to ensure proper operation. A detailed inspection of the lifting slings is performed annually. Nondestructive testing of the slings and crane hooks is performed annually.

Alternate Standard Requirement #7 - A System Assurance Analysis (SAA) has been completed on the 27.5 ton bridge cranes in the O&C. The SAA includes a Failure Modes and Effects Analysis/ Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents).

The SAA identifies one single failure point (SFP), the hoist gear reducer, which transmits power and reduces rotational speed from the hoist motor to the rope drum. A sheared key or broken teeth would cause interruption of the load path at the gearbox. This failure would result in the load dropping, which could cause loss of life and/or payload.

There is no history of failure with the SFP in the critical failure mode. A detailed inspection of the gear reducer is performed monthly, and gear reducer oil samples are verified annually. The use of high-quality, reliable components and a comprehensive maintenance, inspection, and test program (including preoperational checks) ensures that the crane systems operate properly.

The associated SAA CIL Sheets identify all the rationale for accepting the risk of the SFP including design information, failure history, and the operational controls in effect to minimize the risks (maintenance, inspection, test, etc.).

An SAA has been completed on the 30 ton bridge cranes in the SSPF. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents). No critical single failure points were identified during this analysis.

Alternate Standard Requirement #8 - Visual inspections for cracks or other signs of damage or anomalies are performed on the hoist hooks, hoist beams, hoist cables, hoist rod assemblies, and hoist fittings, and crane functional checks are performed before each operation per NSS/GO-1740.9.

Alternate Standard Requirement #9 - Trained and licensed crane operators shall remain at the hoist controls while personnel are under the load.

Alternate Standard Requirement #10 - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

Alternate Standard Requirement #11 - A pretask briefing and a safety walkdown of the area are conducted prior to the lift to ensure that all systems and personnel are ready to support. All participants are instructed on their specific tasks and warned of any hazards involved. Following any crew change, the new personnel are instructed by the task leader on their specific tasks and warned of any hazards involved.

Alternate Standard Requirement #12 - Personnel beneath the suspended load will be in voice contact with the hoist operator and/or task leader. Upon loss of communication, the operation shall stop immediately, personnel shall clear the hazardous area, and the load shall be safed. Operations shall not continue until communications are restored.

Alternate Standard Requirement #13 - Personnel working beneath the load shall be in continuous sight of the hoist operator and/or task leader.

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